

# **EYE CONSTRUCTION FOR A TOY DOLL**

## **BACKGROUND OF THE INVENTION**

### **1. Field of the Invention**

The present invention relates to an eye construction for a toy doll, and more particularly to a doll eye capable of generating slight movements of eyeballs and eyelids by electrifying memory alloy wires adopted in the eye construction.

### **2. Description of Related Art**

To create novel, interesting and funny products that can catch the attention of consumers is a key aim for a toy designer. It is noted that the beautiful appearance was a dominant factor in earlier times, however interaction functions in toy products have become the most required feature nowadays.

For example, dynamic functions such as to swing limbs of the doll or to play music have become integrated in the present toys. In general, it is much easier to accomplish and control a larger movement on a doll than tiny actions. However, slight movement may be necessary to express some exquisite actions such as the eyeball rotation.

For the toy eyes, it is desired to control the eyeballs and eyelids, such as being able to generate rotating and blinking. A particularly well known way for controlling the eyes is that the eyelids can be gradually closed while the doll is lying down, and vice versa. However, the foregoing movements are still not good enough to replicate the real action.

## **SUMMARY OF THE INVENTION**

The main objective of the present invention is to provide an eye

1 construction that can generate exquisite movements such as the eyeball rotation  
2 and eyelid blinking by the use of memory alloy wires.

3 Other objects, advantages and novel features of the invention will  
4 become more apparent from the following detailed description when taken in  
5 conjunction with the accompanying drawings.

#### 6 BRIEF DESCRIPTION OF THE DRAWINGS

7 Fig. 1 is an exploded perspective view of an eye construction for a toy  
8 doll in accordance with the present invention;

9 Fig. 2 is a perspective view of the eye construction for a toy doll in  
10 accordance with the present invention;

11 Fig. 3 is a control circuit diagram of the present invention;

12 Fig. 4 is a schematic cross-section view showing the movement of the  
13 eyelid of the present invention;

14 Fig. 5 is another schematic cross-section view showing the movement of  
15 the eyelid of the present invention;

16 Fig. 6 is a cross-section view showing the movement of the eyeball of  
17 the present invention;

18 Fig. 7 is another cross-section view showing the movement of the  
19 eyeball of the present invention; and

20 Fig. 8 is still another cross-section view showing the movement of the  
21 eyeball of the present invention.

#### 22 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

23 With reference to Figs. 1 and 2, an eye construction of the present  
24 invention is composed of a hollow housing (10), an eyelid body (20), an eyeball

body (30), an eyelid moving control plate (40), an eyeball moving control plate (50), a plurality of memory alloy wires (60) and a control circuit board (70).

The housing (10) comprises an upper case (11) and a lower case (12) that correspondingly combine together, where a mouth (not numbered) is thus defined at one side of the housing (10). The upper and lower cases (11)(12) are both defined with several apertures (14)(15). A frame body (13) has a hemispherical shell in which a hole is defined, wherein the frame body (13) is attached at front of said mouth of the housing (10).

The eyelid body (20) is formed by a hemispherical shell on which an opening (21) is defined, where the upper portion of the eyelid body (20) as the upper eyelid is wider than the lower portion. A pair of first stubs (22) protrude from an outer surface of the right and left sides of the eyelid body (20), with which the eyelid body (20) is pivotally attached inside the housing (10) and behind the frame body (13). With reference to Figs. 4 and 5, a lengthwise block (23) integrally extends from an edge of the eyelid body (20) and near the stub (22).

The eyeball body (30) is formed as a hemispherical ball, where a front arcuate surface of the hemispherical ball is used for forming the pupil pattern. Two second stubs (31) are respectively formed at the top and bottom sides of the outer surface of the eyeball body (30). The eyeball body (30) is pivotally attached inside the housing (10) via the second stubs (31) and behind said eyelid body (20). As shown in Fig. 6, a lateral block (33) is formed at a center of the inner surface of the eyeball body (30).

The eyelid moving control plate (40) has two buckling protrusions (41)

1 formed at an upper edge and a lower edge of the plate (40) to correspondingly  
2 insert through the apertures (14)(15) of the upper and lower cases (11)(12). An  
3 outer surface of the eyelid moving control plate (40) is defined with two  
4 concavities (not shown in the drawings) each of which is communicated with a  
5 rectangular hole (not numbered) defined through the plate (40). A first pushing  
6 rod (42) and a second pushing rod (43) are retained in the concavities of the  
7 eyelid moving control plate (40). One distal end of each pushing rod (42)(43) is  
8 formed as a stepping block (421)(431) from which a column (422)(432) extends.  
9 When the two stepping blocks (42)(43) are retained in the concavities, the two  
10 columns (422)(432) protrude through the two rectangular holes. Several wire  
11 protrusions (44) are formed on an inner surface of the eyelid moving control  
12 plate (40) so that two memory alloy wires (60) can twist around the wire  
13 protrusions (44). Each memory alloy wire (60) has two ends that respectively  
14 connect to a first conductive member (61) and a second conductive member (62).  
15 Each first conductive member (61) is securely mounted on the inner surface of  
16 the eyelid moving control plate (40). Each second conductive member (62) is  
17 further buckled to a spring (63) and is moveable relative to the eyelid moving  
18 control plate (40). It is noted that the two columns (422)(432) on the stepping  
19 block (421)(431) are individually connected to a respective second conductive  
20 members (62).

21 The arrangement of the eyeball moving control plate (50) is  
22 substantially the same as the aforementioned eyelid moving control plate (40).  
23 The eyeball moving control plate (50) also has two buckling protrusions (51) for  
24 correspondingly inserting through the apertures (14)(15). Third and fourth

1 pushing rods (52)(53), each having a stepping block (521)(531) and a column  
2 (522)(only one column is shown on the drawing) are attached to an outer surface  
3 of the eyeball moving control plate (50), wherein the control circuit board (70) is  
4 further placed beside the two pushing rods (52)(53). Two memory alloy wires  
5 (60') are twisted on wire protrusions (54) formed on an inner surface of the  
6 eyeball moving control plate (50) like the arrangement of said two alloy wires  
7 (60).

8 The control circuit board (70) is electrically connected to each spring  
9 (63)(63') and each first conductive member (61)(61') to determine which  
10 memory alloy wire (60)(60') should be provided with a current.

11 The preferable material for the memory alloy wires (60)(60') is nickel-  
12 titanium alloy. The physical characteristic of such an alloy wire is that the  
13 molecule arrangement density will be varied with the temperature and thus  
14 occurring a deformation on the shape. That is, with the increasing of the  
15 temperature, the alloy wire will be lengthened, and once the temperature is  
16 lowered, the alloy wire returns to its original length. Based on the physical  
17 characteristic, if a current is applied on the memory alloy wires (60)(60'), the  
18 heat caused from the current will result in the increase of the wire length.  
19 Otherwise, once the current is cut off, the memory alloy wires (60)(60') will  
20 resume the original status.

21 With reference to Fig. 3, a microprocessor controls the activation of four  
22 transistors used as the switching elements. The foregoing four memory alloy  
23 wires (60) (60') are respectively connected to the four switching elements in  
24 series, where a current limiting resistor is connected between the operating

1 voltage ( $V_{cc}$ ) and one memory alloy wire (60)(60') as an over-current protection  
2 element. With the activation of the switching element, a current from the  
3 operating voltage ( $V_{cc}$ ) flows through the current limiting resistor, the memory  
4 alloy wire (60)(60') and the activated switching element to ground.

5 With reference to Fig. 4, the viewing direction of the cross-section plan  
6 is from the outer surface of the eyelid control moving board (40) and some  
7 elements such as the eyeball body (30) are omitted from the drawing for the sake  
8 of clarity. When a current flows through the memory alloy wire (60) that links to  
9 the first pushing rod (42) via the second conductive member (62), the length of  
10 the memory alloy wire (60) is reduced. Because one end of the memory alloy  
11 wire (60) is connected to a fixed first conductive member (61), and the other end  
12 is connected to a movable second conductive member (62), the second  
13 conductive member (62) is moved forward and thus drives the first pushing rod  
14 (42) to thrust against an upper edge of the lengthwise block (23) of the eyelid  
15 body (20) while the alloy wire (60) is contracted. Therefore, the eyelid body (20)  
16 will slightly move downward to imitate the blinking action.

17 On the contrary, with reference to Fig. 5, when the lower edge of the  
18 lengthwise block (23) is pushed by the second pushing rod (43), the eyelid body  
19 (20) is opened.

20 With reference to Fig. 6, where there is no current applied to the memory  
21 alloy wires (60') mounted on the eyeball moving control plate (50), the third and  
22 fourth pushing rods (52)(53) have no movements so the eyeball body (30) is  
23 faced forward. As shown in Fig. 7, while the third pushing rod (52) is moved  
24 forward to press against a left side of the lateral block (32), the eyeball body (30)

1 turns to the right side. Similarly, as shown in Fig. 8, while the fourth pushing rod  
2 (53) presses against a right side of the lateral block (32), the eyeball body (30)  
3 turns to left.

4           It is to be understood, however, that even though numerous  
5 characteristics and advantages of the present invention have been set forth in the  
6 foregoing description, together with details of the structure and function of the  
7 invention, the disclosure is illustrative only, and changes may be made in detail,  
8 especially in matters of shape, size, and arrangement of parts within the  
9 principles of the invention to the full extent indicated by the broad general  
10 meaning of the terms in which the appended claims are expressed.